United States
Environmental Protection
Agency

Air and Radiation

EPA420-P-00-002
June 2000

Recognizing the Air Quality Benefits of Local and State Land Use Policies and Projects in the Air Quality Planning Process

DRAFT

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Draft

Transportation and Regional Programs Division
Office of Transportation and Air Quality
U.S. Environmental Protection Agency

NOTICE

This technical report does not necessarily represent final EPA decisions or positions. It is intended to present technical analysis of issues using data which are currently available. The purpose in the release of such reports is to facilitate the exchange of technical information and to inform the public of technical developments which may form the basis for a final EPA decision, position, or regulatory action.

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Executive Summary

Recently states and communities have passed hundreds of ballot initiatives at the state and local level preserving open space, increasing development around transit, and providing for increased brownfield redevelopment. Each of these places has had different reasons--economic, environmental or community goals--for pursuing a chosen development path. In addition, such decisions can help communities improve their environment by reducing vehicular emissions, improving water quality, and remediating contaminated lands.

States and communities are interested in accounting for the air quality benefits of their development choices. The Environmental Protection Agency (EPA) intends that this guidance be an additional tool to encourage the development of land use policies and projects which improve livability in general, and air quality in particular. This effort is intended to complement the efforts of states and local areas, and to provide guidance, flexibility and technical assistance to areas that wish to implement these measures, and count these measures towards meeting their air quality goals.

This guidance describes EPA policies and practices regarding the quantification of air quality benefits of local-, regional-, or state-initiated land use strategies. EPA believes that accounting for air quality benefits, either in State Implementation Plans (SIPs), or through the conformity process, is appropriate for land use policies and projects where EPA has assurance that reduced emissions from transportation sources (cars, trucks, buses, etc.) will result. The guidance presents the conditions under which the benefits of land use policies and projects could be included in a SIP or in a conformity determination, and provides guidelines for quantifying the emissions reductions and meeting EPA reporting criteria. Guidance on quantifying land use strategies not discussed in this document may be discussed in future documents.

In general, you could account for the air quality benefits of land use policies or projects for nonattainment and maintenance areas in one of three ways:

1. including the impacts of adopted land use policies or existing land use projects (built or in the process of being built) in the initial baseline forecast of future emissions in a SIP,
2. including a land use policy or project as a control strategy in a SIP
3. including a land use policy or project in the modeling done for a conformity determination, without including it in a SIP

This guidance notes the conditions under which each approach would be appropriate, and presents the criteria EPA would apply for each approach. In addition, general guidelines for quantifying land use policies and projects in SIPs are provided.

This guidance is consistent with Section 131 of the Clean Air Act, which states, "Nothing in this Act constitutes an infringement on the existing authority of counties and cities to plan or

control land use, and nothing in this Act provides or transfers authority over such land use." EPA is providing this guidance to give flexibility to state and local governments by expanding the number of strategies an area can use to meet its air quality planning requirements.

1.0 Introduction

1.0 What are the goals of this guidance?

The goals of this guidance are to:

- provide background on the purpose of this guidance
- define the terms "land use strategies," "land use policies," and "land use projects" and to explain their significance to the air quality planning process
- describe the options for accounting for the air quality benefits of land use policies and projects in the air quality planning process (i.e., state implementation plans (SIPs), and conformity determinations)
- help you determine which option is best for a chosen land use activity
- help you quantify the air quality impacts of land use changes

1.2 Who might be interested in the issues presented in this guidance?

Increasingly, communities around the country are grappling with the need to develop and grow while at the same time assuring environmental protection and health for their citizens. To meet these needs, communities are beginning to more actively involve government agencies, private organizations, and citizens in collaborative, cooperative transportation, air quality and land use planning processes.

This guidance discusses the links between these processes, and is designed to encourage and aid community-based decision making which results in enhanced environmental protection. While this guidance is primary designed to outline the policy and technical issues related to these planning processes, the ideas presented here will be of interest to a wide variety of groups, including:

- **Academia**
- **Citizens**
- **Community organizations**
- **Financial Institutions**
- **Local government agencies**
- **Private developers**
- **Regional agencies**
- **State agencies**

1.3 Who will use this guidance?

The agencies that have responsibility for quantifying air quality programs will use this guidance:

Air quality agencies – the agencies at the state or local level that prepare air quality plans (known as State Implementation Plans, or SIPs) will use this guidance for quantifying the air quality benefits of land use policies and programs in SIPs.

Metropolitan planning organizations – these agencies prepare transportation plans for metropolitan areas and are responsible for showing these plans "conform" to the goals of the SIP. They will use this guidance for quantifying the air quality benefits of land use policies and projects in conformity determinations.

However, to effectively account for the air quality benefits that may be associated with land use activities, these agencies should seek involvement from a variety of key stakeholders, including local governments, regional planning agencies, state agencies, individuals, community organizations and developers. Since each stakeholder plays a significant yet different role in the transportation and air quality planning processes, communication and consultation is vital to successfully employing land use as a tool for improving air quality.

1.4 How do I know if this guidance is applicable to my community?

This guidance is most relevant for areas that are designated nonattainment or maintenance areas for ozone, PM-10, CO, and/or NO_2.

> **Non-attainment area**: a geographic region of the United States that the EPA has designated as not meeting the National Ambient Air Quality Standards (NAAQS) for specific air pollutants
>
> **Maintenance areas**: an area previously designated non-attainment, which has since met the national standards and has an EPA approved maintenance plan covering at least 10 years

These areas are subject to the requirements of the Clean Air Act, and must submit air quality plans to EPA. These areas must also show that any planned transportation activities are in harmony with their air quality goals.

While this guidance is designed primarily to help areas achieve their air quality goals to meet federal standards, staff in attainment areas may also find this document useful as they explore ways to secure their attainment status in the future.

1.5 Why did EPA develop this guidance?

Many of EPA's stakeholders have suggested that EPA recognize land use strategies that result in improvements in local and regional air quality in the air quality planning process, and have said that they need guidance on how to account for the impacts of these types of strategies. In a survey conducted by EPA in 1998[1], staff and managers in state air agencies and regional planning agencies said that being able to quantify the air quality impacts of land use policies and projects would:

- encourage dedication of funding for research into the impacts of such policies
- educate local and state government officials about land use planning as a tool for transportation and emissions control
- add support to these kinds of policies in regional and local debates
- get people to start to think about the trade-offs between these and other measures

This guidance document is designed to describe how you can use existing EPA policies and practices to get air quality credit for certain land use strategies that reduce emissions from transportation sources (cars, trucks, buses, etc) in your communities. The document also lays out guidance on quantifying the impacts of land use policies and projects involving infill. EPA will continue to provide additional guidance on quantifying other types of land use policies and projects in the future.

Another purpose of this document is to make clear the importance of strong coordination and cooperation between the many parties that are interested in land use planning and air quality policy. Many communities are grappling with questions of what kinds of growth patterns best meet their goals. At the same time, many state air agencies are struggling to identify new ways to meet the state's air quality goals. And, state transportation planners are attempting to serve the communities transportation needs while at the same time making sure their projects don't conflict with existing air quality plans. Since land use patterns can be linked to transportation patterns, and hence air quality (as it is affected by car and truck emissions), collaboration and early involvement of the local, state, and regional government agencies in land use planning, transportation planning, and air quality planning communities, as well as members of the public, environmental and community action organizations, and the development community, is vital to ensuring that the wide array of community goals are adequately considered and addressed for the good of all.

[1] USEPA, *Background Information for Land Use SIP Policy*, EPA420-R-98-012, October 1998.

1.6 What are the key concepts discussed in this guidance?

In this guidance, we consider *land use strategies*, *land use policies*, *land use projects*, and *air quality credit*. Brief definitions are provided below; these topics are discussed in greater detail later in this document

Land Use strategies

- *Land use strategies*, for the purposes of this guidance, are defined as approaches to land use planning that can alter aspects of the urban environment to improve air quality. Such strategies may focus on changes to the built environment that result in a decreased need for cars and trucks as the primary modes of transportation. By reducing the need for driving (and, therefore, reducing the air pollution generated from driving), certain patterns of land development can potentially improve air quality.

Land Use Policies

- In this guidance, *land use policies* are specific policies, programs, or regulations adopted or operated by government agencies to allow and/or to encourage the implementation of land use strategies and result in decreased vehicle miles traveled and emissions of air pollutants.

Land Use Projects

- In some cases, a government agency, a developer, or a community organization may wish to develop a parcel of land in a way that could be shown to reduce vehicle travel and emissions. For example, the city might approve a new development that combines residential, commercial, and recreational uses within close proximity to each other, thus reducing the amount of driving necessary for residents to meet various needs. The air quality impacts of such a *land use project* could then be considered using this guidance.

Air Quality Credit

- Air quality credit is granted by EPA when an area can show that a specific policy or project will result in a reduction of air pollution from mobile sources. In this guidance, EPA explains how air quality credit can be received by areas that can show that their land use policies and projects result in decreased driving and thus, reduced air pollution from cars.

2.0 Linking Land Use and Air Quality

2.1 What is the relationship between land use, transportation, and air quality?

Much has been done to reduce emissions of air pollutants from cars and trucks over the last 25 years. These efforts have focused on the use of technology and tailpipe controls, and have been quite successful at reducing the emissions of criteria air pollutants (carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter, and sulfur dioxide) from transportation sources.

However, since 1952, the number of cars and trucks in the US has more than quadrupled while the US population has less than doubled.[2] Furthermore, the average annual mileage driven by Americans in 1997 (9,567 miles per year) was almost twice as high as it was in 1970 (4,587 miles per year).[3] So, even while emissions rates from individual vehicles have been decreasing, the number of vehicles on the road and the frequency and length of trips has been increasing. This is especially true in areas that are currently experiencing high rates of growth in population and development.

These trends–more cars on the road, people driving more often, and increased trip lengths–are, in some areas, decreasing the impacts of improved emissions technology. To combat these trends, state and local government agencies seeking to reduce emissions from cars are increasingly looking not just at technological strategies, but at strategies to reduce driving.

As local government agencies plan and evaluate the best growth and development strategies to meet their communities' needs, the impacts of these strategies on air quality should also be considered. There is evidence[4] that some types of development patterns necessitate the use of a car, while other types can reduce reliance on cars and trucks for transportation. In some cases, such development patterns can mean shorter and fewer trips, thus reducing vehicle miles traveled (VMT) by cars and trucks and improving air quality; other development patterns have the potential to improve or mitigate air quality problems by providing and promoting alternatives to vehicular travel, such as mass transit, walking, or biking.

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[2] American Automobile Manufacturers Association, World Motor Vehicles Data 1996 Edition, 1998.

[3] Oak Ridge National Laboratory, *Transportation Energy Data Book*: Edition 19, September 1999.

[4] *The Effects of Urban Form on Travel and Emissions: A Review and Synthesis of the Literature, Draft Report,* prepared by Apogee/ Hagler Bailly for the EPA, April 17, 1998.

2.2 Who gets involved in land use decisions?

The land use planning process involves some complex interrelationship between local, regional and state government agencies. In addition, individuals, community organizations, and developers play important roles in the process. The roles of local governments, regional planning agencies, state agencies, individuals, community organizations and developers in the land use planning process are briefly described below:

- **Local governments:** generally responsible for, and have authority over, land use decisions within their borders. They have the authority to issue permits for development and control where and how development occurs. May include city and county government bodies.

- **Regional planning agencies**: play important roles by providing land use and transportation data and analysis of the regional impacts of alternative land use scenarios, but have limited influence on land use decisions. May include Councils of Governments (COGs), which help local governments and the state by preparing land use forecasts, with input from and coordination with local governments regarding expected uses of land within their boundaries, that are used in transportation and air quality planning, as well as economic planning, and/or Metropolitan Planning Organizations (MPOs), which are responsible for regional transportation planning and distribution of state and federal transportation funding. In some cases, the MPO and the COG are the same agency.

- **States agencies:** while states generally delegate land-use planning to local governments and have little direct impact on those decisions, numerous state programs governing taxes, infrastructure funding, highways, and community investment indirectly exert a strong influence on land-use decision. Many states are beginning to evaluate state-level policies that pull development away from community centers and are looking at ways transform those policies into incentives for compact, community-based development.

- **Individuals and community organizations:** can have a significant impact on the direction of policy development through community organizing, ballot initiatives, creation and support of alternative development plans and projects, and participation in public hearings and comment periods related to specific development proposals.

- **Private developers:** can propose a variety of development strategies, including those that can potentially have positive air quality impacts, to local planning bodies; can partner with communities to design developments that are in keeping with local economic, social and environmental goals

All of these groups can influence the direction of land development in their communities through proposing and implementing land use strategies, land use policies and land use projects.

[An example of a how these groups work together in an actual community will be

included in a future draft]

2.3 What are land use strategies?

Land use strategies, as defined in this context, are approaches to land use planning that can alter aspects of the urban environment to improve air quality. Such land use strategies improve air quality by encouraging or creating alternative transportation modes, such as walking, biking and using mass transit. By decreasing people's reliance on cars and trucks for transportation, these strategies ultimately can reduce emissions of pollution from these sources.

Land use strategies generally involve changes to the landscape. For example, a local government agency might develop a city plan that includes a strategy of developing concentrated activity centers within the city. This strategy is designed to encourage pedestrian and transit travel. By creating "nodes" of high-density, mixed use development, this strategy would change the landscape. As a result, changes in travel patterns are expected, and these changes will impact air quality by reducing emissions from transportation sources. It is the *emissions-reduction impacts* of these actual changes in landscape that are potentially quantifiable, and are ultimately what will be used to determine whether or not an improvement in air quality can be demonstrated.

Land use strategies are implemented either indirectly through land use policies, or directly through individual land use projects, and these policies and projects may lead to air quality credit.

The types of land use strategies being considered in this guidance either promote the use of transportation modes other than cars and trucks, or aim to reduce the distances driven by these vehicles by locating a variety of desired services and resources in close proximity to each other. Some examples of land use strategies include:

- ***Transit-oriented development (TOD):*** encouraging moderate- to high-density development along a regional transit system
- ***Infill development:*** any type of new development that occurs within existing built-up areas (may be urban or suburban); includes brownfield development
- ***Mixed-use development*****:** development that locates complementary land uses such as housing, retail, office, services, and public facilities within walking distance of each other
- ***Neotraditional design/pedestrian-oriented development:*** a set of land development and urban design elements with the purpose of creating pedestrian oriented neighborhoods. These elements provide more travel options and greater convenience and access to various factors of daily life, such as housing, workplace, shopping and recreation.
- ***Jobs/housing balance:*** reducing the disparity between the number of residences and the number of employment opportunities available within a sub-region

Some of these land use strategies can reduce air pollution by reducing the length, frequency, and necessity of trips by cars and trucks, while others shift travel modes from automobile travel to

transit, walking, and/or biking. Note that this is not an exhaustive list; other possible strategies exist and are being considered in various communities around the country.[5]

[Examples of actual communities that are employing these kinds of strategies will be included in a later draft]

2.4 What are land use policies and projects?

Land use policies and projects are the means by which land use strategies are realized.

Land use policies, in the context of this guidance, are specific policies, programs, or actions that facilitate the steps needed to bring about the desired changes to the landscape that could reduce driving and improve air quality. In some cases, these policies are actually regulations requiring certain kinds of development in designated areas, while in other cases, these policies may be incentives to encourage desired types of development.

There are many different options for land use policies. The types of land use policy tools that are available differs across levels of government and authority. Local government land use policies generally fall into three categories:

- *zoning regulations*
- *design controls*
- *incentive programs*

Zoning regulations govern the type and intensity of new development. For example, a local government can place limits on the maximum density allowed for new developments in an area; by raising these limits, a change to the zoning regulations can facilitate a change in how the land is used (high density development) and potentially reduce the need for driving. Zoning has traditionally been used to segregate different land uses. For example, residential neighborhoods often are zoned so that office buildings and retail shops cannot be located within the same city block. The local zoning ordinances may also state that another area far from the can only be developed as retail, and a different area can be developed as office space. Segregation of activity centers can lead to more and longer car trips by forcing people to travel by car to get from home to work or from home/work to shopping. A local government could lift these restrictions in certain areas to facilitate mixed use development, thus allowing some people to make more of their trips by walking, biking or using transit.

Local governments can exercise control over site design by employing *design controls* through a design review process, where new projects are brought before a design review board for approval; this review may include addressing air quality issues. Local governments can also develop policies governing the design principles involved in development of new subdivisions.

[5] See Appendix A for additional examples of land use strategies

Local governments may also develop *incentive programs*, which can offer rewards to developers who build in desired locations or who include certain design features in new projects. These rewards may be monetary or non-monetary. For example, some local governments require developers to pay an "impact fee" to cover the costs of infrastructure improvements; a local government might, as an incentive, create a policy to waive these fees for developments that build near transit, or make improvements to the pedestrian and bicycle infrastructure. Local governments can encourage infill development by reducing taxes and fees for building in certain areas of the city. A non-monetary incentive might be to reduce parking requirements for a new development that builds near transit. Incentive programs can also be aimed directly at consumers to facilitate demand for alternative land use types.

Regional and state government agencies can also influence development patterns. These agencies can develop incentive programs that attempt to attract new development to desired areas. Regional and state government agencies can also create policies and programs to educate and encourage local governments to implement certain land use policies. For example, a state or regional air quality agency could work with a local government and fund a pilot project to explore the effects of land use policies on air quality, and use the results to promote similar policies in other cities.

Land use projects are specific developments which aim to meet the goals defined in land use strategies. For example, a developer could propose a project to develop a tract of previously-used land within existing city limits by cleaning it up and redeveloping it to include a variety of residential, commercial, and light industrial uses, with bike paths and mass transit. Depending on the design specifics, this development project could support the strategies of mixed use development, infill development, and neotraditional design.

Private developers, on their own or prompted by non-governmental agencies, can develop projects that incorporate features to reduce vehicle travel, such as mixing retail, housing and office uses, adding pedestrian and bicycle connections, and ensuring high access to transit. A developer might, for example, develop a new community under the principles of neotraditional design or transit-oriented development, not as a function of government policies or incentives, but because of consumer demand for this type of development.

Land use policies and projects that can be qualified and shown to have a positive effect on air quality can be included in state air quality and transportation plans and be given air quality credit.

[Examples of existing policies (local and state) that meet these strategies

2.5 What does EPA mean by giving air quality credit?

When a state air quality agency can quantify and document a reduction in mobile source emissions due to land use policies or projects, the state air agency can receive credit in their SIPs and/or transportation agencies can receive credit in conformity determinations for these

actions. In general, when we use the term "credit," we mean that nonattainment and maintenance areas can account for the air quality effects of a land use policy or project. Credit is given for emissions reductions that can be attributed to land use policies or projects.

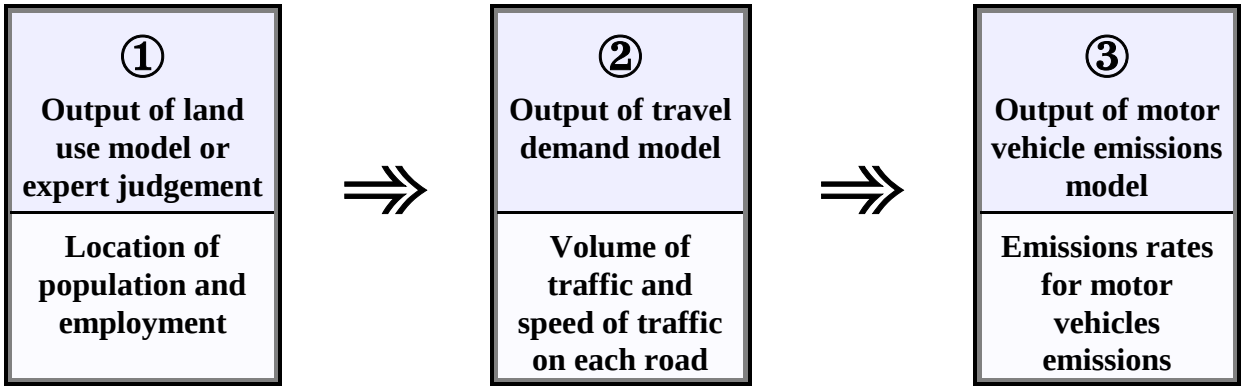
Due to the complexities involved in both land use policies and emissions trading programs, EPA is not prepared to present guidance on how to incorporate land use policies into trading programs. Therefore, in this document, the word "credit" does not refer to tradeable emissions credits. However, we are continuing to evaluate the feasibility of incorporating land use strategies into emissions trading, and seek comment on this issue.

2.6 How do land use policies and project translate into air quality credit?

Emissions of air pollution from automobiles are a function of how many trips people make using these vehicles, how far they have to drive, and the types of vehicles they drive. The way land is developed–how residences, jobs, shopping, recreation, and other destinations are situated within an area--has an impact on the length and number of auto trips that are necessary, which, in turn, affects emissions. Transportation and air quality planners must estimate future pollution levels from motor vehicles in their SIPs and conformity processes. (See section 3.1 for definitions and descriptions of these processes) To calculate the amount of pollution from motor vehicles, planners would need to consider the ways that land is being used in the area and the road network that has been developed to support those uses. A very basic outline of this estimation process is given below.

Areas use either land use models or expert judgement to project where housing and employment are likely to be located in the future. The future location of housing and employment are inputs to the transportation modeling process. In this process, an area is divided up into travel analysis zones. The number of households and employment in a zone affects how much travel will occur in and between zones. Employment is used to represent not only work activities, but also shopping, lunch and other types of trips. In some areas, the travel demand model also produces estimates of trips by mode. Travel demand forecasting models also estimate the number of vehicular trips that use particular routes in the transportation system and estimates the speeds in which they operate. Vehicle miles of travel (VMT) is calculated using this output. This data is directly used to estimate mobile source emissions. Emission rate models are used to estimate emissions rates for the area, taking into consideration factors such as the mix of vehicles types, speed, etc. These rates are then applied to the VMT estimates to calculate mobile source emissions.

Figure 1. Relationship between land use modeling, transportation planning and emissions modeling.



Land use policies and projects that result in people making fewer and/or shorter auto trips can have a positive effect on air quality. The ease or difficulty of quantifying the impacts of these policies and projects will depend heavily on the type of model you use, the capabilities of that model, and the type of policy or project you are examining.

3.0 Accounting for emissions reductions from land use policies and projects

3.1 What Clean Air Act requirements and EPA policies are relevant in this guidance?

The Clean Air Act directs state air quality agencies to prepare air quality plans (called State Implementation Plans, or SIPs) for nonattainment and maintenance areas. SIPs include estimates of future air quality and plans to attain appropriate air quality standards. The area's metropolitan planning organization and, subsequently, the U.S. Department of Transportation, are also required to show that the area's planned transportation activities are consistent with (or "conform" to) the purpose of the SIP; this process is known as the transportation conformity process. A general description of the characteristics and requirements of these processes follows.

State Implementation Plans (SIPs)

A state's air quality agency (generally a branch of the state's environmental protection, natural resources, or public health department) prepares SIPs with input from the state's Department of Transportation, the state's major sources of emissions, and members of the public.

States are directed to submit SIPs for their nonattainment and maintenance areas. There are several kinds of SIPs that are required under different circumstances. The ones that are relevant to this guidance are control strategy SIPs (15% plans, rate-of-progress plans, and attainment plans) and maintenance plans. The control strategy SIPs must include an initial baseline forecast of the area's future emissions -- that is, emissions in the year(s) addressed by the SIP that will result if no additional control measures are implemented other than what is required by law. The SIP also must include a description of specific programs (or "control strategies") that will be used to achieve the needed emission reductions in the area, and calculate future emissions that result when the control strategies are considered. The area must adopt enough control strategies to show that it will:

- meet the standards in the future attainment year (shown in SIPs called "attainment demonstrations");

-or-

- continue to meet the standard after attainment is reached (shown in SIPs called "maintenance plans").

Ozone areas have additional SIP requirements. Before attainment is reached, an ozone area must:

- make progress in meeting the ozone standards (shown in SIPs called "15% plans," and

"rate-of-progress plans");

EPA developed two special SIP policies which allow for inclusion of specific types of measures; they are defined in the Economic Incentive Program (EIP) guidance and the Voluntary Mobile Source Emissions Reduction Programs (VMEP) policy. These types of SIP programs are further described later in this document.

The total allowable emissions in a SIP is the amount of emissions the area can have, and still achieve the goal of the SIP (progress, attainment, or maintenance). The portion of the total allowable emissions that is allocated to highway and transit vehicle use is called the motor vehicle emissions budget, referred to hereafter as "the budget." The SIPs described above -- 15% plans, rate-of-progress plans, attainment demonstrations, and maintenance plans -- almost always contain budgets. Motor vehicle emissions must stay within these budgets.

The conformity process

The transportation conformity process links transportation and air quality planning. The conformity process is designed to make sure that new investments in transportation infrastructure do not worsen air quality or interfere with the "purpose" of the SIP. To show that transportation activities conform, the MPO, and subsequently the U.S. Department of Transportation (DOT) must show that the area's future emissions from the transportation sector meet the budgets in the SIP (in cases where an area does not yet have a SIP in place, a different type of test is used). The estimate of future emissions done for the conformity determination includes all planned non-exempt transportation projects.

3.2 How are the SIP process and the conformity process related?

The conformity process ensures consistency between the SIP and the transportation planning process. Specifically, the process makes sure that the emissions resulting from transportation projects are consistent with those allocated to transportation in the SIP.

In order for states to comply with the conformity regulation, extensive coordination and cooperation among multiple agencies--EPA, the MPOs, offices of DOT (the Federal Highways Administration (FHWA) and the Federal Transit Administration (FTA), and state and local transportation and air quality agencies–must occur. This coordination and consultation process is as *interagency consultation.* Interagency consultation is a formal process to establish procedures for consultation between these agencies. The SIP must establish interagency consultation procedures for all of the agencies involved. In addition, proactive efforts to encourage early and continuing public participation in decision making are required.

3.3 What are the different ways that I can claim credit for a land use policy or project?

There are three basic ways of accounting for the effects of land use policies or projects in nonattainment and maintenance areas:

A. including the impacts of existing land use policies or projects in the initial baseline forecast of future emissions in a SIP;
B. including a land use policy or project as a control strategy in a SIP; and
C. including a land use policy or project as a control strategy in a conformity determination without including it in the SIP.

These three options are discussed in detail in sections 4.0, 5.0, and 6.0.

4.0 Including land use policies or projects in the initial baseline forecast of future emissions in the SIP

4.1 What is the initial baseline forecast of future emissions?

The initial baseline forecast of future emissions is the level of emissions in the future forecast year that will result if no additional control measures are implemented other than what is required by law. It is the baseline level of emissions before any additional explicit measures are taken to improve air quality. This forecast accounts for the impacts of policies that are already adopted and transportation projects that have already been built or will be completed by the forecast year. It also includes effects of Federal regulations or programs that will come into effect by the forecast year (for example, new vehicle emission standards).

4.2 When is an initial baseline forecast of future emissions made?

This initial baseline forecast of future emissions is made when an area prepares a SIP. Therefore, an area that is not in the process of developing a SIP would not consider this option.

4.3 When can I include a land use policy or project into the initial baseline forecast of future emissions?

It is appropriate to include land use policies and projects into the initial baseline forecast only if they have already been adopted and are actually going to occur or have occurred.

You could include a land use policy in the initial baseline forecast of future emissions only if it has already been adopted by the implementing agency. For example, if a city government has adopted a new zoning code which requires or allows for new development within the city limits to be mixed use, the effects of that law should be included in the baseline forecast. However, if the zoning code is only proposed and not yet adopted, it could not be included in the baseline.

You could include a land use project in the initial baseline forecast of future emissions only if it has already been built, or is under construction at the time the forecast is done. All the land uses that currently exist would be included in the initial baseline forecast. If a project is planned for but hasn't been committed to (e.g., construction has not begun), it could not be included in the baseline.

What is described in this section is not a new policy. When your area calculates its baseline, you are supposed to estimate emissions based on the land use and transportation network that exists, or is most likely to exist based on the best available information.

5.0 Including a land use policy or project as a control strategy in the SIP

5.1 What is a control strategy?

A control strategy is a specific strategy used by non-attainment areas and maintenance areas. By reducing ambient air pollutant levels, control strategies satisfy Clean Air Act requirements–either by attaining the standards, demonstrating reasonable progress towards attainment, or maintaining the standard. A land use policy or project that can be shown to reduce emissions can be considered a control strategy.

5.2 When do I need to include control strategies in the SIP?

If you are in the initial stages of preparing your SIP, you can include land use measures with all of your other control measures which reduce emissions. If you have already submitted a SIP, but discover that you need additional reductions, you can do a SIP revision or a stand-alone land use SIP to account for a control strategy or a group of strategies.

5.3 What are the general requirements for including a land use policy or project as a control strategy in a SIP?

To include a land use policy or project in a SIP,

- it must be consistent with the purpose of the SIP
- it must not interfere with other requirements of the Clean Air Act, and
- resulting emission reductions must be:

1. **Quantifiable:**	the emission reductions can be reliably calculated, and the calculations can be replicated
2. **Surplus**:	reductions are not otherwise relied on in air quality programs included in your SIP or SIP related requirements, or other applicable requirements
3. **Enforceable:**	actions required to achieve emissions reductions are independently verifiable, program violations are defined, and those liable for violations can be identified, and penalties can be applied where applicable
4. **Permanent:**	emission reduction occurs throughout the life of the measure, and for as long as it is relied upon in the SIP
5. **Adequately Supported:**	the State or responsible party must demonstrate adequate personnel and program resources to

implement the program

For land use measures, you will generally meet these requirements by providing the following information to EPA:

- a complete description of the land use policy or project and its estimated emission reduction benefits;
- evidence that the land use policy or project was properly adopted by a jurisdiction with legal authority to commit to and execute the measure;
- evidence that funding has been (or will be) obligated to implement the land use policy or project;
- evidence that all necessary approvals have been obtained from all appropriate government entities (including state highway departments if applicable);
- evidence that a complete schedule to plan, implement, and enforce the land use policy or project has been adopted by the implementing agency or agencies[6]; and
- a description of the monitoring program to assess the measure's effectiveness and to allow for necessary in-place corrections or alterations.

These requirements may vary slightly depending on the particular policy used to implement a program. If you have questions regarding these requirements, consult with your regional EPA office.

[6]Land use policies or projects implemented under the VMEP policy may not need to meet all these requirements. Check with your EPA Regional Office to determine if this requirement is applicable to your policy/project. See section 5.7 on the VMEP for more details.

5.4 What EPA SIP programs and policies would help me to incorporate land use policies and projects as control strategies?

There are several SIP programs/policies that could help you incorporate land use policies and projects as control strategies in a SIP. The Clean Air Act (1990 amendments) specifically identifies two types of measures and programs which could relate to land use policies and projects[7] :

- Transportation Control Measures (TCMs) - defined in Section 108(f),
- Economic Incentive Programs (EIPs) - defined in Section 182 (g)(4), and

In addition, there are cases where the Voluntary Mobile Source Emissions Reductions Programs policy could apply to land use policies and projects.

Transportation Control Measures (TCMs) are actions to adjust traffic patterns or reduce vehicle use to reduce air pollutant emissions. Some examples of TCMs include ride-share programs, high-occupancy vehicle lanes, and transit lines. Section 108(f)(1)(A) provides sixteen examples of TCMs, but other transportation-related measures which reduce emissions or concentrations of air pollutants from transportation sources by reducing vehicle use or changing traffic flow or congestion conditions can also be TCMs. Note that vehicle technology-based or fuel-based measures are not TCMs.

TCMs may be included in a SIP if needed to demonstrate attainment of the NAAQS. In areas where TCMs are included in the SIP, the State or the MPO must make sure that all TCMs are funded in a manner consistent with the SIP's implementation schedule. The conformity process is designed to ensure timely implementation of TCMs, thus reinforcing the link between SIPs and the transportation planning process.

Economic Incentive Programs are programs that encourage emissions reductions though market-based incentives. However, as stated in the Clean Air Act, any program which includes incentives and requirements to reduce vehicle emissions and vehicle miles traveled in the area can be considered an EIP. EPA first issued the Economic Incentive Program (EIP) rules in 1994. The 1994 rules established requirements for EIPs specifically mandated by the Clean Air Act, and served as guidance for discretionary EIPs. EPA is currently developing new Economic Incentive Program Guidance to apply to discretionary economic incentive programs - those not specifically mandated by the Clean Air Act (The September 1999 draft version of this guidance is available at http://www.epa.gov/ttn/ecas/innostra.html).

In addition to the Clean Air Act-defined programs, in 1997, EPA released the Voluntary Mobile

[7]These programs are not mutually exclusive. Transportation Control Measures can be included in a SIP as Economic Incentive Programs.

Source Emissions Reductions Programs Policy. The purpose of this policy was to provide added flexibility for state and local governments interested in developing voluntary programs and including them in their SIPs. This policy, also known as the "Voluntary Measures Policy" or VMEP policy, relies on the voluntary actions of individuals or businesses to achieve emissions reductions. Because these actions are voluntary, they are not directly enforceable against the party taking the action.

If you decide to include your land use policies or projects as control strategies in a SIP, there are different reasons why you might want to use one of these policy options. The following sections will help you determine which option is best for you.

5.5 How are land use policies and projects related to TCMs?

TCMs are supportive and complementary to land use policies and projects. A land use measure could include or be supported by transportation projects that are TCMs. These transportation project TCMs may be eligible for funding under the Congestion Mitigation and Air Quality Improvement (CMAQ) program. The CMAQ program was created to provide federal money for transportation projects that reduce emissions in nonattainment and maintenance areas. CMAQ funds have been used for transportation projects that eliminate stop and go traffic conditions, but also for projects that enhance transit, and projects that encourage alternatives to driving alone. The transportation funding act, Transportation Equity Act for the 21st Century, has earmarked $8.1 billion for the CMAQ program over the life of the act. If the transportation project TCMs that meet the CMAQ criteria are included in the SIP, CMAQ funding may be secured.[8] In September of 1990, EPA provided a TCM guidance document entitled "Transportation Control Measure: State Implementation Plan Guidance" which may be beneficial to review.

5.6 How do I know if I should use the EIP guidance to develop and implement my policy or project?

The current draft of EPA's Economic Incentive Program (EIP) Guidance contains very detailed guidance for market- based programs. The guidance describes four categories of EIPs: trading programs, financial mechanisms, public information programs, and clean air investment funds.

Generally, land use policies and projects accounted for under the EIP would fall under the category of financial mechanisms, although it may be possible to address them as trading programs as well. However, due to the complexities involved in both land use policies and emissions trading programs, EPA is not prepared to present guidance on how to incorporate land use policies into emissions trading programs at this time; we are continuing to evaluate the

[8] For more information on CMAQ funding, contact your State Department of Transportation or visit the website at http://www.fhwa.dot.gov/environment/cmaq.htm.

feasibility of incorporating land use strategies into emissions trading, and seek comment on this issue.

An example of an EIP land use policy would be a program that offers some type of monetary reward or incentive to developers. This incentive could be in many forms, including tax breaks, grants, or a fee structure. Alternatively, incentives could also be offered to home buyers or companies moving into areas where development is desired. These monetary incentives could be offered by local, regional, state or federal government agencies, or perhaps even by non-governmental agencies. An EIP land use policy could also work by offering non-monetary incentives, such as density bonuses, relief from impact mitigation, or a streamlined permitting process for sustainable development.

If your policy or project has a strong economic incentive component, such as including a fee structure for new development, you will probably need to include it as an EIP. However, as stated in the Clean Air Act, any program which includes incentives and requirements to reduce vehicle emissions and vehicle miles traveled in the area can be considered an EIP. EIP programs share a very important characteristic with land use policies and projects because they often do not directly control emissions or emission rates. They can achieve reductions indirectly, either through offering incentives to reduce emissions, or through a policy which indirectly impacts the emissions source. For this reason, you may find the EIP guidance helpful as you develop your policy or project.

The current draft EIP guidance provides specific details on how to ensure that incentive programs meet the basic criteria of quantifiable, enforceable, surplus, permanent, and adequately supported as discussed above. In particular, the EIP guidance provides specific instruction on

- creating and implementing an EIP;
- including features to measure and track the results of the program
- evaluating results of the program;
- including reconciliation procedures in the event that the EIP does not meet its predicted emission reduction goals;
- ensuring the program meets SIP requirements for completeness and approvability; and
- ensuring public participation.

If you wish to use the EIP guidance to credit a land use policy, you should contact the appropriate EPA contact for your region. Since the EIP guidance is currently being redrafted, your regional EPA contact can assist you in determining if your program will meet the EIP requirements.

Crediting Innovation and Experimentation:

Accounting for Land Use in a SIP using the Voluntary Mobile Source Emissions Reduction Programs Policy

The Voluntary Mobile Source Emissions Reduction Programs policy, also known as the VMEP guidance or the "voluntary measures policy", was signed October 27, 1997. This policy reflects a major change in how EPA has historically dealt with voluntary measures.

The policy allows 3% of the total reductions needed for attainment in your area to be from voluntary mobile source emissions reduction programs. It provides added flexibility for state and local governments interested in receiving credit in SIPs for voluntary measures by streamlining the process of SIP inclusion of programs with voluntary actions.

VMEPs rely on the voluntary actions of individuals or businesses to achieve emissions reductions. These actions are not directly enforceable against the party taking the action. In other words, the party taking the action is not held responsible if they fail to take the action. In addition, the party can not use the action to offset any other emission reduction requirement. The State must commit to remedy any emissions reduction shortfall in a timely manner if the VMEP program does not achieve projected emission reductions. All emission reductions are credited to the state[3] to meet any Clean Air Act requirement, such as an attainment demonstration, or maintenance demonstration

5.7 How do I know if I should use the VMEP policy to develop and implement my policy or project?

The VMEP policy allows for more innovation than most other EPA SIP programs. It is the appropriate policy to use for many newer programs that lack proven results. In addition, by not requiring that the State directly enforce against a party implementing a measure, businesses and individuals may be more willing to try newer policies and programs.[11] For these reasons, the VMEP may be the appropriate policy to credit many land use policies and land use projects, which have not traditionally been used for to generate air quality credit.

The definition of enforceable for voluntary measures is different than for other SIP programs. Voluntary measures are not enforceable against the source, but the State is responsible for

[11] "State" means a state, local agency, tribe, or other entity that has the authority to submit an implementation plan to EPA for approval under section 110 of the Clean Air Act.

assuring that the emission reductions credited in the SIP must occur. The state must make an enforceable commitment to monitor, assess and report on the emission reductions resulting from the voluntary measures and to remedy any shortfalls from forecasted emission reductions in a timely manner.

In general, for voluntary measures, a state must submit a SIP to EPA which:

1. identifies and describes the voluntary program;
2. contains projections of emission reductions attributable to the program, along with relevant technical support documentation;
3. commits to monitor, evaluate, and report the resulting emissions effect of the voluntary measure;
4. commits to remedy in a timely manner any SIP credit shortfall if the voluntary program does not achieve projected emission reductions; and
5. meets all other requirements for SIP revisions.

Due to the innovative nature of voluntary measures, EPA's inexperience in quantifying them, and the inability to enforce these measures against individual sources, EPA has set a limit on the amount of emission reductions allowed in a voluntary measures program. This limit is set at three percent of the total projected future year emissions reductions required to attain the appropriate standard from all sources (stationary, area and mobile combined).

For some policies and projected, as you gain more knowledge about their impacts and are better able to quantify them, the three percent cap on voluntary measures may eventually be limiting. For this reason, if an emission reduction strategy can meet the EIP requirements, a State may prefer to ask for the strategy to be approved as an EIP. Some strategies might be originally approved under the voluntary measures policy and later, after program evaluations have been completed, be able to be approved as a regular EIP.

5.8 What are the advantages and disadvantages of including a land use policy or project as a control strategy in a SIP?

Including a land use policy or project in a SIP can help you meet your air quality goals by giving you credit for emission reductions that you need to show attainment, demonstrate progress, or demonstrate maintenance. This may be an especially appealing option to areas that are having difficulty attaining, and are seeking all viable options for emissions reductions.

You may also want to have land use policies or projects in a SIP to ensure that they are fully committed to and funded. This may be important for governments agencies wishing to pursue new land use policies and projects–including them in the SIP could be a strong incentive to make sure they happen in a timely fashion.

Some land use policies and projects may require ten or more years before having any significant

impact on emissions from motor vehicle sources. Because some SIPs (e.g., attainment SIPs) generally have shorter time frames than that, in some cases, the air quality benefits of a land use policy or project may not be realized in the time frame covered by the SIP in place when the policy or project is adopted. However, with careful planning, the benefits of a policy or project begun in the attainment planning period could be included in a future maintenance planning period.

5.9 What other important information do I need to know about including a land use policy or project as a control strategy in a SIP?

When determining the air quality benefits of control measures, you may quantify the benefits of several strategies together, or you may choose to model the benefits separately. How you choose to model the benefits could affect how or when you would choose to implement the measure. This means you could

- model the benefits of land use policies with other control strategies cited in your SIP, and quantify the overall impacts of all control strategies,
- model the benefits of several land use policies and projects together as package, or
- quantify the impacts of a land use policy or project separately to determine the impact of that strategy alone.

In any case, you will need to describe the land use policy or project and how it will reduce emissions. General guidance on quantification is provided in section 8.0.

6.0 Including land use policies or projects in the conformity determination without having them in a SIP

6.1 Can I account for the benefits of land use policies or projects in a conformity determination without having them in a SIP?

Land use policies and projects do not have to be included in a SIP. You can account for the benefit of a land use policy or project in a conformity determination without including it in any way in a SIP. An area may benefit through only including land use policies and projects in the regional analysis done for a conformity determination. However, any land use policy or project you choose to include in a SIP should be accounted for in the conformity determination, as long as it is still scheduled to occur.

6.2 How do I account for the benefit of land use policies or projects in the conformity determination?

In a conformity determination, as in a SIP, forecasts of future emissions must be made. If your area uses a travel demand model for conformity, then the effects of land use policies and projects should be included all together in the modeling of the transportation network, in the same way as described for the SIP.[12] Even if you modeled projects and policies individually for the SIP, it wouldn't be necessary to do so in the conformity determination. In general, it would be more appropriate to incorporate the benefit of land use policies and projects together in the estimates of future emissions made for the conformity determination. These estimates of future emissions are directly compared to the SIP budgets (if no adequate budgets exist, then different tests would apply, as described in the conformity rule).

Land use policies and projects that are not "regionally significant" don't have to be modeled with a travel demand model.[13] In cases where it is not possible to model the effects of land use policies and projects using a travel demand model, the emissions reductions could be quantified in your conformity determination using another technique. If a land use policy or project that is

[12] The conformity rule states that serious, severe, and extreme ozone nonattainment areas and serious CO nonattainment areas with an urbanized area population over 200,000 must use a travel demand model for their regional emissions analysis. In addition, any area whose already using a travel demand model must also use it for conformity.

[13] "Regionally significant" is a term defined in the conformity rule that applies to transportation projects. It is any transportation project that is on a facility that serves regional transportation need (such as access to and from the area outside of the region, major planned developments such as new retail malls, sports complexes, etc.). The concept of regionally significance is applicable to land use policies and projects as well. For example, a large transit-oriented development that includes retail, employment, and housing would be regionally significant. A small land use project of 10 apartment units might not be regionally significant.

not regionally significant was included in the SIP, you would use the same modeling technique for conformity determination.

There are some areas that don't have travel demand models. In these areas, the emissions reductions associated with land use policies and projects could be quantified in your conformity determination using another technique, regardless of whether they are regionally significant.

An emissions analysis done for a conformity determination must use the latest planning assumptions (see section 93.110 of the conformity rule at 62 FR 43809). This requirement means that the planning assumptions for conformity determination must be derived from the MPO's most recent estimates of current and future population, employment, travel and congestion.

6.3 When is it appropriate to account for the benefits of a land use policy or project in a conformity determination?

Unlike a SIP, conformity determinations are made on a regular basis, and must be updated at least every three years. The conformity determination must use the latest existing information regarding the effectiveness of measures. The conformity determination must reflect what is truly planned at the time the determination is made. Therefore, if you have information that a measure is not occurring, you can not include it in the conformity determination, even if it has been used in the SIP or in past conformity determinations. You can only include land use policies or projects in a conformity determination if they have already occurred, are actually occurring, or if you can demonstrate that you are certain that they will occur (e.g., you have an enforceable commitment for to ensure their implementation). See §93.122(a) of the conformity rule (62 FR 43813). EPA recognizes that in some metropolitan areas or states, there are bodies with special authorities related to land use implementation. EPA and DOT will work with areas to determine what type of commitment is necessary for a land use policy or project to be included in a conformity determination.

6.4 What are the advantages to only modeling land use policies or projects in the conformity determination without having them in the SIP?

First, conformity determinations offer more opportunities to account for land use policies or projects as they happen. Conformity must be redetermined at least every three years, and in practice it's often redetermined annually. In contrast, SIPs are generally prepared at a single time. (Revisions can be made to a SIP at a later date, and you may be required to monitor programs and evaluate programs and make corrections.)

Second, a conformity determination looks at the effects of the land use and transportation system 20 years into the future, because it must examine the 20 year life of the transportation

plan. This is in contrast to SIPs: attainment demonstrations only look as far as the attainment date, which is at most 7 years in the future; maintenance plans require maintenance of the standards for a time period of 10 years. It may take more than 10 years for land use policies or projects to have an impact on travel decisions and therefore air quality; the conformity determination looks at a time frame in which you can see their effects.

Third, an MPO might prefer to have effects of land use policies or projects in a conformity determination that haven't been accounted for in the SIP. These reductions are then "surplus" to the SIP and could be used to offset the emission-creating effects of other projects in the transportation plan.

Last, another advantage of including land use policies and projects in conformity rather than in a SIP is the ease of accommodating changes in the land use policy or project. If the features of the land use policy or project produces fewer emissions than originally thought, or if the policy or project becomes delayed, the change would simply need to be reflected in the next conformity determination. You wouldn't have the problem of having to make up a SIP "shortfall"-- that is, you would not have to revisit your SIP to make up the emissions reductions. You would only need to be sure that the policy or project is correctly reflected in the next conformity determination.

7.0 Additional Considerations for Accounting for Land Use Policies or Projects in the SIP or the Conformity Process

7.1 What happens if I included a land use policy or project in the SIP or the conformity process, and I now have information that the policy or project isn't occurring, or isn't getting the reductions I predicted it would?

You wouldn't be able to include the land use policy or project in the next conformity determination, because the conformity determination must reflect the reality of what is actually occurring. If the conformity determination's estimates of future emissions are greater than the motor vehicle emissions budget(s) in the SIP, then you will need to adjust the transportation plan or add other control strategies to achieve the same emission reductions as the land use policy or project which was planned but didn't occur. This is why it is important that you are confident that the land use policies or projects you are claiming credit for will occur, or have already occurred.

In addition to conformity, there are processes to be aware of on the SIP side. If you included a land use policy or project in a SIP but now it is not occurring, you may not meet the goal of the SIP: further progress, attainment, or maintenance of the standard. EPA may issue a non-implementation finding. If the land use policy or project has been implemented but is not getting the reductions that you anticipated, EPA may issue a SIP call, which means that the state air quality agency will have to reevaluate the programs in the SIP and resubmit it to EPA.

7.2 How will the time frame for implementing the land use policy or project impact how I take credit?

Areas which are designated nonattainment have a defined period of time to reach their air quality goals. Depending on the land use policy or project you are implementing, you may find that the benefits won't occur until after you are required to attain. In such cases, you may find that it is to your benefit to take credit for the policy or project in a maintenance plan. The maintenance period is 20 years, covered by two 10-year maintenance plan (the second is submitted 8 years after the first). Alternatively, you may chose to take credit for the policy or project a conformity determinations, which involves a 20 year transportation plan.

8.0 Guidelines for Quantifying Land Use Policies and Projects

8.1 What is the goal of these guidelines?

The primary goal of these guidelines is to outline the general requirements required for quantifying the air quality benefits of land use policies and programs for inclusion into a State Implementation Plan (SIP). This chapter of the guidance is written primarily for the technical staff at air quality and transportation agencies who are responsible for different aspects of SIP development and transportation air quality modeling. Because of the inherent interactions between land use, transportation and air quality, it is very important that staff from the air quality and transportation agencies work together to identify appropriate projects and policies, and to select the models and methodologies to estimate the benefits. Throughout this chapter, "you" refers to those staff.

In general the quantification for a SIP submittal shares many common aspects with transportation planning and the conformity process. While these guidelines may provide some useful information, you should follow the requirements outlined in the Department of Transportation's metropolitan planning regulations (23 CFR 450) and EPA's conformity rule (40 CFR Parts 51 and 93) when doing transportation planning or conformity.

8.2 How will EPA assist me with quantification?

EPA intends to develop methodology options and examples for individual types of land use policies and projects to assist you in addressing quantification issues specific to those policies and projects. The first of these guidance documents will be on quantifying the benefits of infill development for SIP purposes, and an EPA study on infill development is being released in concurrence with this guidance. It is expected that this study will be the basis for EPA's guidance on infill quantification. EPA will continue to develop quantification methodologies, and will release other policy-specific guidance documents over time. Staff in your EPA regional office will work with you to ensure that the quantification of your policy or project will meet all the requirements for inclusion in the SIP or conformity determination.

8.3 How do land use policies and projects affect air quality?

Land use policies and projects can affect air quality by influencing how or how much people travel by altering:

- the way land is developed - how residences, jobs, shopping, recreation, and other destinations are situated within an area, or
- the way people access those destinations - walking, biking, transit, private automobile

These factors can have an impact on the length and number of auto trips that are necessary, which, in turn, would affect emissions from mobile sources, and this would impact air quality.

To include a land use policy or project in a SIP or a conformity determination, you will need to quantify these air quality effects. EPA has outlined the general steps you will need to undergo to quantify these impacts in SIPs in sections 8.4 through 8.6.

8.4 How do I quantify the impacts of land use policies and projects on travel and air quality?

If your land use policy or project would likely change where housing and/or employment will be located in the future, these changes could impact the transportation systems and air quality in your area. The agencies responsible for transportation planning and air quality planning have general procedures in place for quantifying the impacts of policies and other control strategies. Wherever possible, you should generally use these same procedures to quantify the impacts of land use policies and projects, though the procedures can vary slightly for individual policies and projects.

There are three general steps in quantifying the air quality or emissions impacts of land use policies and projects. These are:

1. Estimating the policy's/ project's impacts on location of housing and employment;
2. Estimating the impact of housing and employment on travel activity; and
3. Estimating the impact of travel activity on emissions of air pollutants.

To assess the impacts of your land use policy and project on transportation and air quality, you must first predict where housing and employment will be located, both before and after the policy is implemented. Several areas use land use models to estimate future land use development, but many use expert judgement. While EPA will certainly recognize the use of land use models, we recognize that they can be expensive and difficult to run, and therefore may not be practical to run for individual policies or projects. In these cases, alternative methods of quantification may be used; EPA will provide examples of such methodologies in future guidance documents.[14]

Next, you must estimate the impact of these changes on travel activity–that is, the number of trips people take, the length of the trips, and to some extent, the mode of travel used. In metropolitan areas, the agencies responsible for transportation planning use a four-step travel demand model to estimate future travel demand. In the four step modeling process, an area is

[14] EPA will be releasing an draft document outlining several methodologies for estimating the air quality impacts of infill developments shortly after this draft is released.

divided up into travel analysis zones. The number of people that will live in a zone and the number of jobs that will locate in a zone in some future year affects how much traffic will go from each zone to every other zone. The transportation model (or travel demand model) determines the routes that traffic will most likely travel (more complex models include estimates of how many trips will be made using transit). Using these models, planners can determine how many cars are likely to travel on each road (traffic volumes), and, based on that, their average speeds.

Generally, you should use the same procedures to estimate the changes in travel demand resulting from land use policies and projects. However, there may be some circumstances where this is not feasible. For example, some land use policies and projects affect small areas, or include very specific design changes–these are known as *microscale* land use polices and projects.[15] Specific examples include neighborhood design projects such as improved sidewalks, bicycle facilities, narrow streets and greater street connectivity. Transportation models generally are not equipped to estimate the effects of these types of policies, and you may need to use off-model sketch planning techniques.

After you have calculated the changes in travel activity , you must then calculate the impact on vehicle emissions. The EPA requires that you use the latest version of the MOBILE model to calculate vehicle emissions, with the exception of California, where the EMFAC model is used. Guidance on using the MOBILE model is available at http://www.epa.gov/otaq/models.htm. For vehicles and/or equipment not represented in these emission models you should use reputable data from actual testing programs or other EPA recommended models. .(e.g. alternative fueled vehicles are not modeled in MOBILE). If you believe you need to use a method in addition to MOBILE or EMFAC because the model will not adequately address your situation, you should check with your EPA regional office**.**

You also need to be aware that the use of software packages and models alone does not produce reasonable results. You must estimate, calibrate, and verify the models for your particular area.

8.5 How does the policy I use affect the method of quantification I will need to use?

As mentioned previously, the three main steps in quantifying the mobile source air quality benefits resulting from land use policies and projects center around the way land is developed and the resulting travel activity effects and consequent emission reductions. Several factors will influence which methodology you use to quantify land development patterns and travel activity effects in the SIP. These are:

[15]For a reference source on quantifying microscale land use measures see the FHWA report "Data Collection and Modeling Requirements for Assessing Transportation Impacts of Micro-Scale Design, DTFH61-95-C-00168."

1. What does the quantification need to demonstrate?
2. What is the scale of the land use measure being quantified?
3. What tools, resources, and staff expertise do I have available to quantify the land use measure?

Factor 1: What does the quantification need to demonstrate?

In order to explicitly credit a policy or project (or a set of policies or projects), you must be able to attribute specific benefits to those measures. However, there may be policies or projects which are worth implementing, but where you are unable to quantify with enough certainty the associated emission reductions. The accuracy of quantification can be broken down into three categories:

- *Directionally beneficial* - You can demonstrate that measures have a positive effect on air quality, but are unable to determine the extent of emission reductions, or even the relative magnitude of reductions.

- *General estimates, or "sketch planning" estimates* - You are able to determine the relative magnitude of emission reductions. This level of quantification can be particularly useful if you are comparing two or more policies or projects to determine the appropriate one(s) to implement. In some cases, sketch planning techniques may be acceptable for SIPs In particular, sketch planning may be appropriate for smaller scale projects where the travel activity effects are not expected to be regionally significant, or for projects where more traditional modeling is not feasible. The appropriateness of using sketch planning techniques for SIP modeling should be determined on a case by case basis in consultation with the applicable EPA region.

- *SIP/ quality estimates* - You are able to determine with reasonable certainty the approximate emission reductions associated with a policy or project. Generally, you should use a regional four step transportation modeling process, calibrated and verified for your area, and ensure that air quality and transportation staff are working together to ensure that proper methodologies and assumptions are being used. You can then account for a specific amount of emission reductions in a SIP (Note that the requirements for quantifying the benefits under the voluntary measures policy may be different than for other SIP measures. This is explained more fully in section 8.7.)

You do not necessarily need to perform SIP quality quantification for the quantification to be useful. You may determine for some reason that you do not want or need to explicitly include a measure in the air quality planning process, or simply, you may be trying something new, which you cannot quantify with relative certainty.

If you determine that a measure is directionally beneficial, you may decide it is worth

implementing. You may find that you are able to more accurately quantify the benefits of the policy or project after you have had some experience implementing it. Many areas have included measures in their air quality planning, without explicitly crediting them, as measures which will assist in meeting or maintaining air quality standards.

Sketch planning efforts can be very useful in helping you identify the policies or projects you want to implement. These efforts are likely to require fewer resources and less time than would be required to perform a SIP quality estimate for each policy or project.

SIP quality estimates are estimates that meet the legal requirements for inclusion of the policy or project in a SIP (Sketch planning may be used for SIP credit in some cases.) This can be done in the baseline determination, as a standard SIP submission, or may be included under the somewhat more flexible VMEP program. In general, if a policy or project is included in a SIP, it is also included in a conformity determination, although to be included in a conformity determination it need not be a part of the SIP. See section 6.0 for the discussion of when it is appropriate to account for the benefits of a land use policy or project in a conformity determination.

Factor 2: What is the scale of the land use measure being quantified?

The scale of the land use measure you want to quantify will influence the number and types of quantification methodologies or tools that are available for use. For example, if you are quantifying a project that involves the construction of transit-oriented developments centered around a new light rail line, you should be able to project population growth around these centers using a land use model or expert judgement, and calculate the resultant travel activity effects in a four-step modeling process. However, if you want to quantify the impact of adding sidewalks and passthroughs on "Main Street between 1st and 3rd Streets," a four-step model process will be too coarse to account for these changes. Instead, you may have to conduct a different type of analysis, such as before and after traffic counts or some equivalent measure, to determine the effects of this development on pedestrian/vehicle traffic patterns. (For a reference source on quantifying microscale land use measures see the FHWA report "Data Collection and Modeling Requirements for Assessing Transportation Impacts of Micro-Scale Design, DTFH61-95-C-00168).

Factor 3: What tools, resources and staff expertise do I have available to quantify the land use measure?

EPA is aware that there is a wide disparity in land use and travel demand forecasting capabilities in the various metropolitan areas across the United States. In the study, "Evaluation

of Modeling Tools for Assessing Land Use Policies and Strategies (EPA420-R-97-007, August 1997), 12 of 25 areas studied used a land use model, while the rest relied on expert judgement. The use of land use models can be costly and time consuming but can add some degree of confidence in the resulting travel activity effects and associated emission reductions.

In contrast, in metropolitan areas, transportation planning agencies consistently use a four-step travel demand model to estimate future travel demand, though the specific model used varies . Generally, you should use the same four-step model to estimate the changes in travel demand resulting from land use policies and projects.

Given that even the best land use modeling is an imprecise art, EPA recommends that all land use emission estimates be treated conservatively, and those relying only on expert judgement even more so. Ultimately air quality attainment is demonstrated by air quality monitoring. Overestimated benefits can lead to difficulty in meeting attainment.

8.6 What general steps must I follow to quantify the benefits of land use measures for inclusion into a SIP?

The first step in quantifying the effects of any land use measure is to make sure that you have accurately characterized the SIP emissions baseline. The SIP baseline reflects expected future emissions due only to conditions as they are at the time of the analysis. This includes land use policies and projects that already exist or are underway. The emissions baseline includes information such as: assumptions about the regions land use mix, zoning, travel demand, population, and growth estimates. Whether you are including a land use measure in a completely new baseline estimate or are revising the existing baseline estimate to incorporate a new land use measure you will need to follow the steps below to quantify and incorporate the land use measure into your baseline.

If you are taking credit for the land use measure as an explicit control measure in your SIP you will need to compare the existing baseline with the new measure added to the existing baseline. In some cases, the adoption of the new land use measure may necessitate you construct a hypothetical baseline to accurately decide whether a project is good for air quality and to determine actual benefits. This distinction is best illustrated with an example:

> A city decides to promote infill as a land use strategy and decides to redevelop an old brownfield site within the city. It is likely that people who move to the newly renovated brownfield site would have otherwise settled somewhere else in the city's metropolitan area. You may therefore be able to assume that some or all of this growth is replacing growth that is assumed in your SIP baseline. (If it were all additional growth, the new development would actually increase emissions as compared to the baseline.) However, because the project is occurring in a portion of the region, it may not be possible to compare the project directly to the SIP baseline. You can however, construct a baseline for the level

of growth related to the project which approximates the conditions represented in the SIP baseline. You will need to demonstrate that it is reasonable to assume that a project or policy is replacing growth that is assumed in the SIP baseline.

By comparing the two new scenarios you may make a determination if overall the brownfield site redevelopment is good for air quality and to what magnitude, i.e. is concentrating population in the brownfield redevelopment plan better for the region's air quality than spreading people out according to the baseline's expected population distribution?

For a reference tool on constructing a hypothetical baseline see the EPA document on quantifying the air quality benefits of infill development.[16]

There are six general steps you should follow to quantify land use policies and projects in a SIP. They are:

1. Completely describe the land use policy or project
2. Describe how employment and housing and other infrastructure are affected by the measure
3. Describe how you determined the travel activity effects arising from the land use policy or project
4. Determine the confidence you have in estimate of travel activity effects and apply an applicable discount factor use appropriately conservative estimates.
5. Determine the emissions reduction associated with the travel activity effects
6. Demonstrate that the emissions reductions are surplus

Step 1: Completely describe the land use policy or project

You should describe the land use policy or project as completely as is reasonably possible. You should describe what the policy or project is, the actual physical changes that will result, population effects, zoning, density, the goals of the land use policy or project, travel activity effects and emission reduction potential. If you are taking credit for your land use policy or project as a control strategy, you will need to meet all of the specific documentation requirements specified in section 6.

[16]EPA will be releasing a draft document outlining several methodologies for estimating the air quality impacts of infill developments shortly after this draft is released. EPA will use this document to draft guidance on quantifying SIP benefits for infill projects.

Step 2: Describe how employment and housing and other infrastructure are affected by the policy or project

You should include in your analysis, an economic forecast, employment location, and household location, as well as any other pertinent infrastructure information. You should use accepted land use models. Check with your Regional EPA or DOT office for assistance in determining a model appropriate to your area. Many areas use expert judgement to estimate future land use and/or to determine the assumptions that underlay modeling. EPA will accept the use of expert judgement for SIP credit, however you may want to use conservative estimates reflective of the confidence you have in the assumptions.

Step 3: Describe how you determined the travel activity effects arising from the land use policy or project

You should describe your methodology as completely as is reasonably possible. Information normally used in transportation planning analysis or conformity analysis should be utilized where they exist so that all assumptions are consistent. If you decide to, or are using a model, you may want to consult with your local regional EPA or DOT office as to which models are commonly used or applicable to your circumstances.

EPA and DOT have been conducting research in order to assist states and cities to quantify the emission benefits associated with land use measures. You may find the following resources useful:

- Evaluation of Modeling Tools for Assessing Land Use Policies and Strategies, EPA420-R-97-0007
- Comparing Methodologies to Assess Transportation and Air Quality Impacts of Brownfields and Infill Development - (OP--ICF draft document)
- Air Quality Impacts of Regional Land Use Policies (EPA–UC Davis Sacramento Study–draft report)
- Data Collection and Modeling Requirements for Assessing Transportation Impacts of Microscale Design (FHWA–KPMG Peat Marwick LLP draft report)
- Projecting Land-Use Change: An Evaluation of Models for Assessing the Effects of

Community Growth and Change on Land Use Patterns–(ORD–draft; not available until December 2000)

- NCHRP 423 Land Use Impacts of Transportation
- TCRP Report 48- Integrated Urban Models for simulation of Transit and Land Use policies:(1999) References, National Academy Press 1999. Sponsored by the Federal transit Administration (FTA)
- TMIP- Urban Design, Telecommuting, and Travel Forecasting- Conference Proceedings -DOT-T-96-09, Final Report, Feb, 1995
- TMIP- Land Use Modeling Conference Proceedings
- TMIP- Land Use Compendium - DOT-T-99-03, July 1998
- TMIP- Land Use Forecasting Studies

Step 4: Determine the confidence you have in the travel activity effects

Many factors can influence the accuracy and/or quality of your predictions of travel activity effects. For example, some Factors influencing the confidence you have in your estimate include:

• analysis zone size	The smaller the zone, the better able the model can predict interactions.
• socioeconomic and travel data quality	The more detailed your data, the more accurately you can characterize the impacts of your policy/project
• the age of your data.	The older the data, the less confidence you should have in your results.

EPA recommends that you consider the confidence you have in your estimates when taking credit for a policy or project in the SIP, and that you use reasonably conservative estimates of the benefits.

Step 5: Determine the emissions reductions associated with the travel activity effects

You should always use the EPA or California approved emission factors that appear in the MOBILE model or the EMFAC model if the land use measure is in California. For vehicles and/or equipment (e.g. alternative fueled vehicles) not represented in these emission models you should use reputable data from actual testing programs.

You should always use the best data available when running the MOBILE or EMFAC model. Local data should be used when available..

Step 6: Demonstrate that the emission reductions are surplus

You must make sure that your quantification methodology only counts reductions that are surplus. Emission reductions used to meet air quality attainment requirements are surplus as long as they are not otherwise relied on in air quality-related programs related to your SIP, SIP-related requirements, or Federal rules that focus on reducing criteria pollutants or their precursors.

You will need to coordinate closely with other program offices in your air quality planning section to insure against inadvertent double-counting (i.e. taking credit for reductions that have already been credited or assumed elsewhere.) For land use policies and projects, you need to pay special attention to the transportation planning and SIP baseline to insure that the reductions are above and beyond the existing baseline land use assumptions.

8.7 What additional specific quantification requirements must I meet to include my policy or project as a voluntary measure?

The Voluntary Measures Policy was crafted in part to allow new and innovative programs with less established quantification methodologies to be included in a SIP. See the section on voluntary measures for a more complete description of the policy. (The voluntary measures websites is located at: http://www.epa.gov/oms/transp/traqvolm.htm. This does not eliminate the need to use the most advanced quantification techniques when they exist or are practical to use, however. If you can use existing land use models and travel demand models, i.e. the four-step process, you should do so. For measures that do not lend themselves to quantification by the four step process you can use other logical methodologies to quantify the emission benefits. The Voluntary Measures Policy should generally be used for non-traditional quantification efforts. (There may be some exceptions to this, which should be handled on a case by case basis.) At such time that emission benefits are proven to be reasonable and accurate, these methodologies may "graduate" into being allowable for traditional SIP measures. It should be noted that programs under the voluntary measures policy can be no more than 3% of the total reductions needed for attainment in your area.

8.8 What additional specific quantification requirements must I meet if I include my policy in a conformity determination without including it in the SIP?

For a conformity determination, we recommend that you incorporate the benefit of land use policies and projects together with all of your other control strategies to estimate future emissions. These estimates of future emissions are directly compared to the SIP motor vehicle emission budgets (if no adequate budgets exist, then different tests would apply, as described in the transportation conformity rule, 40 CFR parts 51 and 93).

Also, when performing a conformity determination, you should follow the requirements outlined in the Department of Transportation's metropolitan planning regulations (23 CFR 450) and EPA's conformity rule (40 CFR Parts 51 and 93) when doing transportation planning or conformity.

Land use policies and projects that are not regionally significant don't have to be modeled with a travel demand model.[17] In fact, it may not be possible to model the effects of some land use policies and projects using a travel demand model, and if that is the case, then the emissions reductions could be quantified in your conformity determination using another technique.

8.9 What other important issues should I be aware of in quantifying air quality benefits?

There are a number of additional issues you should consider when quantifying the air quality benefits of land use policies and projects. These include:

- The synergistic or antagonistic interactions between policies and projects
- Deciding whether to quantify the benefits of policies and projects individually, or with other policies and projects.
- Ensuring your estimates are conservative enough, and the potential consequences of not being conservative.
- The effect of the scale of your project can have on the uncertainty associated with your estimate of emissions reductions.

Accounting for interactions between policies and projects

[18] "Regionally significant" is a term defined in the conformity rule that applies to transportation projects. It is any transportation project that is on a facility that serves regional transportation need (such as access to and from the area outside of the region, major planned developments such as new retail malls, sports complexes, etc.). The concept of regionally significance is applicable to land use policies and projects as well. For example, a large transit-oriented development that includes retail, employment, and housing would be regionally significant. A small land use project of 10 apartment units might not be regionally significant.

Relationships between land use and travel are complex. Land use policies and projects may interact with each other, either enhancing the emissions reductions they achieve, or in some cases diminishing the beneficial effects. You will need to consider the potential interactions of a policy or project with other control strategies when you are quantifying the effects.

Quantifying policies and projects individually or as a group

You may quantify the benefits of land use policies and projects as part of a group of control strategies or quantify the impacts on a land use policy or project separate from the other control strategies to determine the impact of that strategy alone. The quantification procedures are somewhat different for quantifying a group of control strategies as opposed to quantifying an individual policy or project.

Calculating the benefit of control strategies together can result in fewer modeling steps. If you model several strategies together, you will need to calculate a baseline without the projects and policies, and compare that to a calculation of the emissions with all of the policies and projects. Quantifying the effects of policies and projects together will likely better capture the interactions and synergies produced by several land use policies or projects.

If you model strategies individually, you will need to run a separate calculation for each project. In order to take into account the interactive effects described above, whenever feasible, you should run the model accounting for previously modeled policies and projects in your baseline. That is, you should estimate the benefits of policies and projects in a series, continuously building on previous policies and projects.

By determining the explicit amount of emissions reduced by a single land use policy or project, you can determine the air quality benefits of that control strategy and the cost effectiveness of pursuing it. This will allow you to compare several control strategy options in terms of emissions reductions and cost-effectiveness. In addition, by going through the process of calculating the benefits of the measure, you are likely to gain more insight into how the measure is working. Calculating a specific benefit for the measure can also help explain the effectiveness of the measure to the public. This can be particularly important if indicating its effectiveness is needed for it to be adopted.

Using conservative estimates

Throughout this chapter, we outlined several places where you should make conservative estimates. Modeling the air quality impacts of land use policies and projects is an inherently uncertain process, and it is important that you are confident in the emissions benefits that you account for in a SIP or conformity determination. If you overestimate the reductions for policies and projects, you ultimately may not meet the air quality standards. If a land use policy or project does not result in the expected emission benefits, you will have to find new reductions to make up for the shortfall.

Taking into account the scale of the project or policy

Land use and transportation models are likely to more accurately predict the benefits of a project or policy when it's impact is large in scale. For projects with larger impacts, the law of averages will tend to even out outlying discrepancies, whereas projects and policies with smaller impacts will be more effected by individual variation. You need to be aware that for very small projects and policies, the inherent errors in the modeling can even be greater than the modeled benefits of the project. The scale of the project can therefore greatly impact the confidence levels of the modeling, and therefore the amount of credit you claim.

8.10 What impacts other than air quality should I consider?

Land use policies and projects will have multiple environmental and economic effects. You will likely implement a policy or project because of a number of benefits, including improvements in air quality. For example, you may implement policies and projects to preserve open space, or provide for increased brownfield redevelopment. These policies and projects can reduce vehicular emissions, but also can improve water quality or help you remediate contaminated lands. In some cases, however, a policy or project might have a positive effect on air quality but a negative effect on another factor. You should always consider these effects when you are quantifying the impacts of policies and projects.

8.11 What other resources are available to assist me with quantification?

Other resources that will be made available in the near future that may be useful include:
[We request comment on the applicability of these and other tools.]

Smart Growth Index

A GIS-based sketch-level planning tool for evaluating alternative growth, land use, and transportation scenarios for communities and regions (draft)

TRANSIMS

The Transportation Analysis and Simulation System (TRANSIMS) is an advanced urban tranportaition/ air quality analysis and forecasting model designed to be used by local planning agencies to simulate the movement of vehicles and people for an entire metropolitan region. (draft)

Projecting Land-Use Change: An Evaluation of Models for Assessing the Effects of Community Growth and Change on Land Use Patterns

The EPA Office of Research and Development has developed an evaluation of land-use change models in order to improve its ability to assess and mitigate future risk to

ecological systems, human health, and quality of live. The document identifies and evaluates 25 different modeling tools (draft available in Fall, 2000)

Appendix A Examples of Land Use Policies and Strategies

Some examples of Land Use Strategies include:

• Concentrated activity centers:	Encourage pedestrian and transit travel by creating “nodes” of high density mixed development, that can be more easily linked by a transit network.
• Strong downtowns:	Encourage pedestrian and transit travel by making the central business district a special kind of concentrated activity center, that can be the focal point for a regional transit system.
• Mixed use development:	Encourage pedestrian and transit travel by locating a variety of compatible land uses within walking distance of each other.
• Infill and densification:	Encourage pedestrian and transit travel by locating new development in already developed areas, so that activities are closer together.
• Increased density near transit stations:	Encourage transit travel by increasing development density within walking distance (0.25 to 0.50 miles) of high capacity transit stations, and incorporate direct pedestrian access.
• Increased density near transit corridors:	Encourage transit travel by increasing development density within walking distance (0.25 to 0.50 miles) of a high capacity transit corridor.
• Pedestrian and bicycle facilities:	Encourage pedestrian and bicycle travel by increasing sidewalks, paths, crosswalks, protection from fast vehicular traffic, pedestrian-activated traffic signals, and shading.
• Interconnected street network:	Encourage pedestrian and bicycle travel by providing more direct routes between

locations. Also, alleviate traffic congestion by providing multiple routes between origins and destinations.

- Strategic parking facilities: Encourage non-automobile modes of transit by limiting the parking supply, and encourage carpooling by reserving parking close to buildings for carpools and vanpools.

Some examples of Land Use Polices include:

I. Encourage focused higher density by
   A. allowing transfer of unused development density capacity in outlying areas to permit development density above maximum limits near central areas and transit (zoning/regulations and non-monetary incentives);
   B. allowing increased density for residential, retail, and employment generating uses in central areas and around transit (zoning/regulations and non-monetary incentives);
   C. setting minimum densities for residential, retail, and employment generating uses in central areas and around transit (zoning/regulations);
   D. requiring no net decrease in residential density for redevelopment (zoning/regulations);
   E. stating densities in terms of square feet of land per dwelling unit, rather than minimum lot size, to encourage clustering (zoning/regulations);
   F. granting incentives (e.g., reduced parking requirements, accelerated permit processing, infrastructure upgrades) for development that focuses on existing urban areas and infill (non-monetary incentives);
   G. adjusting development impact fee structures or giving tax breaks to encourage infill and increased density development near transit and activity centers, and to discourage outlying development (monetary incentives).

II. Encourage mixed-use zones by
   A. Allowing mixed use, which is now prohibited in many places (zoning/regulations);
   B. requiring mixed uses, with certain percentages of residential, public, and commercial uses in target areas (zoning/regulations);
   C. using fine-grained zoning to achieve mixed use while insuring residential zones are buffered from heavy industrial zones with light industrial and commercial zones (zoning/regulations);
   D. using mixed-use overlay zoning, to add a second use to an area that is primarily in another use, e.g., commercial corridors along major arterials

in a primarily residential area (zoning/regulations);

E. granting incentives (e.g., reduced parking requirements, accelerated permit processing, infrastructure upgrades) for development that locates transit- or pedestrian-oriented amenities, like housing or child care near commercial uses and pedestrian-oriented design (non-monetary incentives);

F. adjusting development impact fee structures or giving tax breaks to encourage mixed use (monetary incentives).

III. Encourage pedestrian, bicycle, transit, and carpooling activity by

A. requiring connected, narrower streets with trees and sidewalks in new development (zoning/regulations);

B. requiring bicycle lanes and transit stops on larger streets in new development (zoning/regulations);

C. requiring traffic-calming devices in new development, e.g., textured paving at crossings, frequent intersections with pedestrian-activated traffic signals, and traffic circles (zoning/regulations);

D. reducing requirements for setbacks and minimum lot sizes to create a stronger connection between buildings and sidewalks (zoning/regulations and non-monetary incentives);

E. requiring pedestrian scale signs in pedestrian and transit-oriented areas (zoning/regulations);

F. reducing minimum parking requirements near transit hubs and for projects providing features that encourage pedestrian, bicycle, and transit activity (zoning/regulations and non-monetary incentives);

G. setting parking maximums in transit- and pedestrian-oriented areas (zoning/regulations);

H. requiring preferential parking for carpools (zoning/regulations).

Appendix B Related Internet Web Sites

Smart Growth Network
http://www.smartgrowth.org

Transportation Action Network
http://www.transact.org

Sustainable Communities Network
http://www.sustainable.org

Growth Management Institute
http://www.gmionline.org

U.S. Department of Energy, Center of Excellence for Sustainable Development
http://www.sustainable.doe.gov

The U.S. Conference of Mayors, Joint Center for Sustainable Communities
http://www.usmayors.org/uscm/sustainable/sj-7.htm

National Governors Association, Center for Best Practices
http://www.nga.org/Center/Activities/SmartGrowth.asp

Presidents Council on Sustainable Development
http://www.whitehouse.gov/PCSD/

National Trust for Historic Preservation
http://www.nthp.org

Planners Web: Sprawl Resource Guide
http://www.plannersweb.com/sprawl.html

Center for Neighborhood Technology
http://www.cnt.org

Oregon Transportation and Growth Management Program
http://www.lcd.state.or.us/issues/tgmweb/about/index.htm

BUILDER Online, July 1998 special report on Sprawl
http://builder.hw.net/monthly/1998/jul/covstory/sprawl4.htx

City of Austin, Smart Growth Initiative
http://www.ci.austin.tx.us/doorstep/98/10/smartgrow.htm#anchor1055467

New Jersey Pinelands Comprehensive Management Plan
http://www.state.nj.us/pinelands/cmp.htm

Smart Growth in Maryland
http://www.op.state.md.us/smartgrowth/

Appendix C Related Work Efforts

[Note: all of the documents cited below will be available on EPA's website at http://www.epa.gov/oms/transp/traqsusd.htm for the final release of this guidance document]

Comparing Methodologies to Assess Transportation and Air Quality Impacts of Brownfields and Infill Development

This work, performed by ICF consulting under contract with the EPA Office of Policy, describes four possible methodologies for including the emissions reductions produced by brownfields redevelopment and infill development in State Implementation Plans (SIPs). Each methodology examined here is a different answer to the question: if the infill development for which emissions credit is being claimed had not been built, where would the development —the "growth increment"—have gone instead?

Methodology 1: Growth would have gone to a single "typical" greenfield site

Methodology 2: Growth would have gone to the fastest-growing parts of the region

Methodology 3: Growth would have been distributed through the region, in amounts determined by the local land use model

Methodology 4: Growth would have been distributed through the region, in amounts proportional to the distribution of all other growth.

The draft report details the steps taken to quantify the impacts of an infill development in Atlanta, Georgia, and compares this infill site to growth scenarios if the infill site was not developed. This draft report is being released for public comment in June, 2000 for 60 days and is intended to serve as the basis of EPA guidance on quantifying infill for air quality credit in SIPs.

A Methodology to Establish SIP Creditability of Infill Development

This work was conducted by Apogee/Hagler Bailly and Criterion under EPA's Office of Policy (OP), which preceded the work by ICF mentioned above. Preliminary work performed is described in a draft report entitled *The Transportation and Environmental Impacts of Infill versus Greenfield Development: A Comparative Case Study Analysis*. This study uses regional travel demand modeling to compare the travel and emissions impacts between a hypothetical development located on an infill site and on a greenfield site. Models were run for three case studies, in San Diego, California; Montgomery County, Maryland; and West Palm Beach, Florida. Each case study consisted of modeling a hypothetical large development as if it were located on an actual infill site, and then modeling the same development as if it were on an actual greenfield site. The development size remains the same in both locations, but the density and street patterns are consistent with the surrounding urban form at each location. In

each case, the MPO travel demand model was used to simulate the travel impacts of the development. Environmental impacts (including NOx and CO_2 emissions) and energy use were estimated using a GIS-based model called INDEX.

All three case studies show that locating the development on the infill site results in lower vehicle use and lower vehicle emissions. VMT per capita at the infill sites was roughly half that at the greenfield sites. NOx emissions were 27 percent to 42 percent lower at the infill sites, even though congestion at one infill site was higher than the greenfield site. It should be noted that the INDEX model uses simplified per-mile and per-trip emissions factors, not the standard vehicle emissions models.

Transportation Impacts of Micro Scale Urban Design Elements: Data Collection and Modeling Needs

This 1998 joint DOT (FHWA)/EPA (OMS and OP) funded project will bring together current knowledge and recent research concerning the ability to appropriately reflect the transportation impacts of various micro-scale urban design elements (e.g., sidewalk width, building setback, street grid type, etc.). A report from the contractor conducting the study, Parsons Brinckerhoff, should be available in late 1999. The report will explain procedures to estimate how land use development strategies and site design elements affect travel behavior and will give examples from selected MPO experience. Particularly useful for MPOs will be a product that will relate specific urban design changes to auto ownership, trip generation (or tour or activity generation), and mode choice for use in current travel demand models.

Air Quality Impacts of Regional Land Use Policies

This 1998 joint OP/OMS-funded grant to Robert Johnston at the University of California, Davis will produce a document for policy makers at the national, state, and metropolitan levels that illustrates the air quality benefits or deficits of regional policy scenarios that affect land use development patterns. Policies that affect land use directly, such as removing density caps on zoning around rail stations, and indirectly, such as travel pricing or transit investment, will be simulated. A suite of models is under development that utilizes earlier work done in the Sacramento metropolitan area. Numerous scenarios will be evaluated and compared to the expected baseline out to the year 2015. Scenarios having strong effects on region-wide accessibility and affecting demand for travel or land significantly (e.g., new road capacity, major region-wide transit capacity expansion, or strong travel and parking pricing policies) will be evaluated. In addition, plans call for evaluation of scenarios that include land market pricing corrections, such as incentives for infill development, and land development fees for raw land projects at the urban edge and beyond.

The simulations of land use, transit, and travel pricing scenarios for the Sacramento region using the regional MPO's travel demand model are complete. Part two of the project is underway. This will evaluate the best two or three scenarios, using two urban models that represent land development and travel, MEPLAN and an improved TRANUS. These results

will give differences that take into account land use pricing and give indications of the magnitude of land use price differentials for the various outcomes. Results will be compared to the less resource intensive modeling technique previously used.

The Effects of Urban Form on Travel and Emissions: A Review and Synthesis of the Literature

This is an ongoing contract with Apogee/Hagler Bailly under EPA's Office of Policy (OP). The draft report offers a thorough summary of recent research on the effect of land use on travel behavior. Studies fall into two general categories. Empirical studies compare data collected from actual communities and try to distinguish how various land use factors lead to different travel patterns. Simulation studies use computer models to examine the impact of hypothetical land use patterns on travel and emissions.

The report concludes that changes in land use can reduce region-wide vehicle use and emissions over a period of several decades. Using simulation models, several studies have convincingly shown that modifying future development patterns in ways that make them less dependent on automobile use will reduce VMT and emissions. The reduction in emissions comes from shorter trip lengths and shifts to transit, bicycling, and walking modes. While computer modeling has improved greatly in recent years, it is still subject to some serious limitations. Zonal size generally precludes modeling the impact of micro-scale design features, for example.

The report documents how numerous empirical studies have shown relationships between specific land use factors and components of travel demand. For example, compact clusters of mixed-use development are correlated with reduced trip lengths. Similarly, higher density communities of mixed land use are associated with higher shares of travel by transit, bicycling and walking. The report acknowledges the methodological flaws that limit the conclusions that can be drawn from empirical studies. Some, for example, do not control for factors like income when comparing neighborhoods. A more fundamental flaw is the fact that cross-sectional studies, by nature, cannot establish causality.

Evaluation of Modeling Tools for Assessing Land Use Policies and Strategies

This complementary effort was done for the EPA Transportation and Market Incentives Group by Systems Application International (SAI). Its final report was issued in August 1997. The work was intended to assess how regional land use forecasting models are able to incorporate specific land use policies. The report evaluates three commercial land use models: DRAM/EMPAL, MEPLAN, and TRANUS. Each model was evaluated in terms of how well it could account for policies designed to (1) increase development densities, (2) increase land use mixing, and (3) modify design elements and infrastructure to encourage alternative travel modes. The specific policies used to achieve these goals were summarized as zoning, monetary incentives (such as subsidies to developers to build in targeted areas), and non-

monetary incentives (such as reduced parking requirements).

The study concludes that DRAM/EMPAL, because it does not easily represent costs, cannot model the impact of any of the three types of policies. MEPLAN and TRANUS do include representations of development costs, and therefore can at least partially model zoning policies as well as monetary and non-monetary incentives. The report points out that all the models are seriously constrained by zonal size, however. They are usually run using zones the size of several census tracts, or a single census tract at the smallest. As a typical urban census tract is roughly one square mile, a model built on zones of this size could possibly detect an increase in density within a half-mile of a transit station or transit corridor; it could not detect smaller-scale land use changes. If the zonal system uses aggregations of census tracts, even transit station-area densities could not be resolved.

Green Development with the National Association of Home Builders Research Center

Past research has demonstrated that the location of new development has a strong correlation with its environmental impact. For example, far-flung residential subdivisions will generate more air pollution than "close-in" mixed use communities.

Beyond the location of development (far-flung versus close-in), research demonstrates that various development practices and techniques on the development site can mitigate environmental impacts. For example, proximity to transit, reduction in street width, grid lay-out for streets, construction of sidewalks and pathways, and co-location of diverse land uses (e.g., residential and commercial) will all improve community walkability and help reduce reliance on SOVs. TMIG's cooperative agreement with the NAHB Research Center will generate a compendium of various development practices and techniques that create a range of environmental benefits. The "guidebook" will provide information on various green development techniques and will lay-out the steps for developing local, community-based green development programs. The development guide is being refined through a partnership with the Denver Home Builders Association, which is currently creating a "Green Developers Program" for local builders.

U.S. EPA Inventory and Evaluation of 25 Land-Use Change Models

Many potential clients for land-use change models, such as city and county planners, community groups, and environmental agencies, need better information on the features, strengths, and limitations of various model packages. Because of this growing need, the U.S. Environmental Protection Agency (EPA) has developed a selective inventory and evaluation of 25 leading land-use change models currently in use or under development. Partners in scoping this effort included the U.S. Departments of Transportation and Interior, the academic and consulting communities, and multiple program offices across EPA.

EPA’s Office of Research and Development (ORD) initiated the land-use change models

evaluation in order to improve its ability to assess and mitigate future risk to ecological systems, human health, and quality of life. Land-use change is perhaps the most significant source of adverse impacts to aquatic and terrestrial environments today. Through its Regional Vulnerability Assessment and other initiatives, ORD is considering land-use change models at nested spatial scales in order to target ecological resources and socioeconomic issues for community-based protection efforts. The strategic evaluation of leading models achieves the following ORD objectives:

1) identify models that are immediately available for application at multi-county and watershed scales in rural and urban areas;

2) evaluate model frameworks for their ability to support alternative algorithms currently under development within ORD; and

3) assess the suite of inventoried models for gaps and weaknesses that ORD may seek to address through in-house research and external research grants.

Target user groups for the land-use change models evaluation are:

a) Community planners and citizens who are seeking tools to analyze future land-use scenarios;

b) EPA program office and regional staff who support communities with smart-growth planning tools and information; and

c) ORD modelers and research planners who are currently assessing land-use models and gaps in the state of the science.

The inventory is scheduled for completion in hardcopy format by September 30, 2000. An interactive internet version will be available in 2001. Work is also underway to develop a related inventory of models that project the environmental impacts of land-use change. For more information, please contact Laura Jackson at jackson.laura@epa.gov or (919) 541-3088.

Appendix D Glossary of Terms

Air quality credits

The documented reductions in mobile source emissions due to land use policies or projects that nonattainment and maintenance areas can use in their State Implementation Plans (SIPs) or conformity determinations.

Attainment demonstration

An area considered to have air quality that meets or exceeds the U.S. Environmental Protection Agency (EPA) health standards used in the Clean Air Act. An area may be an attainment area for one pollutant and a non-attainment area for others.

Baseline

The level of emissions before any explicit measures are taken to improve air quality.

Brownfields

Abandoned, idled or under-used industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination.

Conformity

Process to assess the compliance of any transportation plan, program or project with air quality control plans. The conformity process is defined by the Clean Air Act (CAA).

Control strategy

These are specific strategies for controlling the emissions of and reducing ambient levels of pollutants in order to satisfy CAA requirements for demonstrations of reasonable further progress and attainment.

Criteria pollutants

Criteria pollutants are carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO2), ozone (O3), particulate matter (PM), and sulfur dioxide (SO2).

Economic Incentive Program (EIP)

Strategies that encourage emissions reductions through market based incentives.

Infill development

A type of land use strategy. Specifically any type of new development that occurs within existing built-up areas (may be urban or suburban); includes brownfield development.

Initial baseline forecast

The initial baseline forecast of future emissions is the level of emissions in the future that will result if no additional control measures are implemented other than what is required by law.

Jobs/housing balance

A type of land use strategy. Changes that reduce the disparity between the number of residences and the number of employment opportunities available within a sub-region.

Land use policy

Specific policies, programs or regulations adopted or operated by government agencies to allow and/or to encourage the implementation of land use strategies and result in decreased vehicle miles traveled and emissions of air pollutants.

Land use project

Specific developments which aim to meet the goals defined in land use strategies.

Land use strategy

Strategies/changes that alter aspects of the urban environment to improve air quality.

Maintenance area

Any geographic region of the United States previously designated nonattainment pursuant to the CAA Amendments of 1990 and subsequently redesignated to attainment subject to the requirement to develop a maintenance plan.

Mixed use development

A type of land use strategy. Development that locates complementary land uses such as housing, retail, office, services and public facilities within walking distance of each other .

Mobile sources

Motor vehicles, nonroad equipment (e.g., construction equipment, lawnmowers, boats, locomotives, etc.), and their fuels.

National Ambient Air Quality Standards (NAAQS)

Standards for pollutants considered harmful to public health and the environment. NAAQS have been set for the six criteria pollutants.

Neotraditional development

A type of land use strategy. Specifically a set of land development and urban design elements with the purpose of creating pedestrian oriented neighborhoods.

New Source Review

Air pollution permits are required for businesses that build new pollution sources or make significant changes to existing pollution sources. These are sometimes referred to as "preconstruction" or "new source review" permits. These permits are required to ensure that large new emissions do not cause significant health or environmental threats and that new pollution sources are well-controlled.

Nodes of high density, mixed use development

A concentrated area or central area of various types of developments.

Non attainment area

Any geographic region of the United States which has been designated as nonattainment for any pollutant for which a national ambient air quality standard exists.

Regionally significant

A term which has been defined in federal transportation planning regulations as a transportation project that is on a facility which serves regional transportation needs (such as access to and from the area outside of the region, major activity centers in the region, major planned developments such as new retail malls, sports complexes, etc. or transportation terminals as well as most terminals themselves) and would normally be included in the modeling of a metropolitan area's transportation network, including at a minimum all principal arterial highways and all fixed guideway transit facilities that offer an alternative to regional highway travel.

State Implementation Plan (SIP)

State air quality plans required by The Clean Air Act for nonattainment and maintenance areas. The plans are prepared by state air quality agencies and include estimates of future air quality and plans to attain appropriate air quality standards.

Transit oriented development

A type of land use strategy. This development encourages moderate to high density development along a regional transit system.

Transportation control measure (TCM)

The term "transportation control measure" encompasses elements of both transportation system management (TSM) and "transportation demand management" (TDM). Transportation system management generally refers to the use of low capital intensive transportation improvements to increase the efficiency of transportation facilities and services. These can include carpool programs, parking management, traffic flow improvements, high occupancy vehicle lanes, and park and ride lots. TDM generally refers to policies, programs and actions that are directed towards decreasing the use of single occupant vehicles. TDM also can include activities to encourage shifting or spreading peak travel periods. In practice, there is considerable overlap among these concepts and TCM, TSM and TDM are often used interchangeably.

Travel analysis zone

Level of geographic detail used in most transportation planning applications to summarize socioeconomic characteristics anc travel data. TAZs vary in size depending on density and homogeneity of and land uses, and are defined by local agencies.

Travel demand model

In the field of transportation there is a standard set of planning methods and models that are called the four-step process or the Urban Transportation Planning System (UTPS for short). This set of models and procedures is used to forecast travel demand for future transportation systems and it plays a central role in the evaluation of alternative transportation plans and policies.

Vehicle miles traveled (VMT)

A standard area wide measure of travel activity. Most conventional VMT calculation is to multiply average length of trip by the total number of trips.

Voluntary Mobile Source Emission Reduction Programs (VMEP)

Voluntary emission reduction programs that rely on the actions of individuals or other parties for achieving emissions reductions. The VMEP Policy is intended to provide an incentive for states, localities and the public to voluntarily reduce air pollution in their communities.

Appendix E List of Acronyms

CMAQ	Congestion Mitigation and Air Quality Improvement program
CO	Carbon Monoxide
COG	Council of Governments
EIP	Economic Incentive Program
EPA	Environmental Protection Agency
MPO	Metropolitan Planning Organization
NO_2	Nitrogen Dioxide
PM-10	Particulate Matter (10 micrometers or less)
SIP	State Implementation Plan
TCM	Transportation Control Measure
TOD	Transit-oriented development
VMEP	Voluntary Mobile Source Emissions Reduction Programs
VMT	vehicle miles traveled

Appendix F References to Relevant Policies, Guidance Documents, and General Information Sources

Granting Air Quality Credit Land Use Measures: Policy Options

EPA420-P-99-028

http://www.epa.gov/oms/transp/traqsusd.htm

Background Information for Land Use SIP Policy, October 1998

EPA420-R-98-012

http://www.epa.gov/oms/transp/traqsusd.htm

Evaluation of Modeling Tools for Assessing Land Use Policies and Strategies, October 1997
EPA420-R-97-007

http://www.epa.gov/oms/transp/traqsusd.htm

Voluntary Emission Reduction Programs Guidance, October 24, 1997

http://www.epa.gov/oms/transp/vmweb/vmpoldoc.htm

Economic Incentive Program Guidance

(to be posted soon)

http://www.epa.gov/oms/transp/traqmkti.htm

Conformity Rule and supplemental documentation

http://www.epa.gov/oms/transp/traqconf.htm

Appendix G Regional and State Contacts

Below is a listing of organizations that may be contacted in order to find out what agencies are responsible for the conformity and/or State Implementation Planning process in any given geographic area.

For State or Local Air Agencies

State and Territorial Air Pollution Program Administrators/Association of
Local Air Pollution Control Officials
444 North Capitol St. N. W.
Washington, D. C. 20001
Telephone: 202-624-7864

For Metropolitan Planning Organizations or Councils of Government

National Association of Regional Councils
1700 K St. N. W.
Washington, D. C. 20006
Telephone: 202-457-0710

For Transit Agencies

American Public Transportation Association
1201 New York Avenue, N. W.
Washington, D. C. 20005
Telephone: 202-898-4000

For State Departments of Transportation

American Association of State Highway and Transportation Officials
444 N. Capitol St. N. W.
Washington, D.C. 20001
Telephone: 202-624-5800

For Environmental Protection Agency Contacts

Questions on transportation conformity or a current listing of non-attainment and maintenance areas should be directed to:

EPA Office of Transportation and Air Quality
2000 Traverwood Drive
Ann Arbor, MI 48105
Telephone: 734-214-4441
www.epa.gov/oms/transp/traqconf.htm

For EPA Regional Offices - Transportation Planning Contact *

Region I: Boston, MA

617-918-1665 (RI, CT)

617-918-1668 (MA, ME, VT, NH)

Region II: New York, NY

212-637-3901 (NJ, Puerto Rico, U.S. Virgin Island)

212-637-3804 (NY)

Region III: Philadelphia, PA

215-814-2183 (DC, MD, VA)

215-814-2184 (DE, PA, WV)

Region IV: Atlanta, GA

404-562-9026 (AL, FL, GA, KY, MS, NC, SC, TN)

Region V: Chicago, IL

312-353-8656 (Il, OH)

312-353-4366 (IN)

312-353-6680 (MI, MN, WI)

Region VI: Dallas, TX

214-665-7247 (AR, LA, NM, OK, TX)

Region VII: Kansas City, KS

913-551-7651 (IA, KS, MO, NE)

Region VIII: Denver, CO

303-312-6446 (CO, MT, ND, SD, UT, WY)

Region IX: San Francisco, CA

415-744-1247 (AZ, NV, CA)

415-744-1231 (CA)

415-744-1153 (CA)

Region X: Seattle, WA

206-553-1463 (AK, ID, OR, WA)

***Please note:** This list is current as of publication date. For the most current list, visit EPA's web site at: www.epa.gov/epahome/locate2.htm

or the TRAQ web site at: www.epa.gov/oms/transp/conform/contacts.htm